

The applications of knowledge creation in pulled and pushed innovation management processes

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Abstract

Innovation is just required nowadays in competitive and complex environment and new idea generation is a competitive advantage for organization. Innovation process is generally classified in to pushed or pulled type. A pushed type is a process that the organizations has access to the new invented technology and try to find profitable applications to use this technology. A pulled process attempts to find customers' needs not met, and then focus development efforts to find solutions to those needs. Innovation process is broken down to 6 phases which are: (1) invention, (2) decision to bring the invention into development, (3) development, (4) decision to produce, (5) production, and (6) marketing. Knowledge management can improve innovation process in organization through knowledge creation. There are different knowledge creation methods such as communities of practice, best practice cases etc.

In this paper, we identify the contribution of these methods in innovation process, and then investigate their application in each of the innovation management phases for pulled and pushed processes individually by using case study method. The results of more innovative and less innovative organization are compared and the efficient methods for each innovation management phase are found. These results are useful for organizations to improve innovation management in new product development by use of the knowledge creation methods.

Key words: Innovation process, Knowledge Management methods, Pulled innovation process, Pushed innovation Process

1. Introduction

Being innovative has become one of the most important factors for organizations in sustaining their competitiveness (Tidd et al., 2002). The innovation process in firms is a process of accumulating and creating new knowledge (Nonaka and Takeuchi, 1995; Zahra and George, 2002). This process involves cross-departmental functioning, that is, employees from different units form a team with different viewpoints (Yang, 2005). Then some methods should be applied to facilitate communication and collaboration among them to share their knowledge. Management of the knowledge and human resource practices to share knowledge is a key success factor of innovation processes that help them for this purpose (Chen and Huang, 2009; Gold et al., 2001; Levinthal and March, 1993; March, 1991). Hoegl and Hoegl (2005) introduced 10 knowledge management methods which are applicable in NPD projects. In related literature, there are the few researches about the effect of using the knowledge management methods on innovation process.

In this paper we show how the use of knowledge management methods can enhance each stage of innovation process separately for pulled and pushed innovation processes. The results are based on two case studies from mobile telephone operator. The remainder of the paper is organized as follows. Section 2 provides a summary of literature review about innovation process and knowledge management. Section 3 describes the innovation process. In section 4 knowledge management methods will be discussed. We present our methodology in section 5. Case studies and findings are

presented in section 6. Finally in section 7 we will offer conclusion, limitation and existing potential for future research.

2. Literature review

Innovation process begins with generating an idea, continues with the idea development, and results in the introduction of a new product, process or service to the marketplace (Edwards and Gordon, 1984). A comprehensive and integrated conceptual model has been developed for innovation process by Bernstein and Singh (2006). The nature of innovation is interconnected and interdependent so that inter-organizational networks contribute significantly to the innovative capabilities of firms by smoothing the progress of idea generation, enhancing the transfer of knowledge and enabling fast access to resources (Carlsson, 1997; Chesbrough, 2003; Malerba, 2004, 2005; Tether and Metcalfe, 2004; Asheim and Gertler, 2005; Powell and Grodal, 2005; Tether & Tajar, 2008). Nowadays it is commonly accepted that there is a complex relationship between Innovation and knowledge flow that play a critical role in successful innovation and new product development processes (Brown and Eisenhardt, 1995; Tidd et al., 1997; Yang, 2005; Popadiuk and Choo, 2006; Todtling et al, 2009). Tether and Tajar (2008) explored the use of specialist knowledge providers in the innovation process. Bertola and Teixeira (2002) presented the role of 'knowledge integrator' and a 'knowledge broker' in innovation processes.

Koskinen and Vanharanta (2002) presented innovation process in 6 stages and showed the important role of tacit knowledge in the initial stages of the innovation process. On the other hand, Hoegl and Schulze (2005) investigated how knowledge management methods support knowledge creation during the development of new products.

In literature of innovation, there are two types of Innovation process called pushed and pulled. According the marketing dictionary definition, pulled innovation process referred to innovation caused or at least stimulated by the needs, wants, or desires of customers. In the other words, if researchers know a customer problem first, and then search for a solution, this is pull method, like airplane invention, after this invention, everybody knows its application.

Pushed innovation process contrasts the pulled and includes a process to invent a new technology that its application is not found yet. This means that researchers develop new technological capabilities first, and then search for problems they can solve with them, this is push method, like Laser beam invention. After invention, the applications are discovered. Under this method, commercial applications are known after technology is developed. Other terms for these two types are market- or customer driven innovation and technology-driven innovation (Marketing Dictionary, 2009; Kolodovski, 2006).

Kolodovski (2006) pointed the key differences between the two methods and explained the ways of setting up the commercialization path of pushed type to improve its efficiency. Ende and Dolfisma (2002) studied on the influence of technology and knowledge factors or market factors as enablers of innovation. Kim and Lee (2009) showed that in inducing technological change, the role of these two types is different and their relative importance changes. This is an important factor in determining the principal forces of technological innovation. The importance of the stage of innovation process is different in these two types but the related literature does not point it.

The aim of this paper is to understand the role of knowledge management methods as stated by Hoegl and Schulze (2005) in each stage of innovation process according to Koskinen and Vanharanta (2002) separately for pulled and pushed innovation processes. In other words, we attempt to know where knowledge management methods can support innovation process stages. The result is based on two case studies where one is more innovative than the other.

3. Innovation process

Innovation is a process beginning with the initiative idea and finishing by introduction of the product to consumers. Innovation process can be divided into the six following stages (Koskinen and Vanharanta, 2002):

3.1. Invention Phase

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In this phase, the idea is generated for new composition, product, or process. A new idea may be derived from a previous model or idea, or it could be independent from them.

3.2. Decision to bring the invention into development phase

In this phase, the decision to devote time and money to complete the idea and eliminate the weakness is made.

3.3. Development phase

Eliminating the weakness of the idea and completion it is performed in development phase.

3.4. Decision to produce phase

Decision to produce phase includes the evaluation of implementation the idea from all related viewpoint and assigning the required budget.

3.5. Production phase

Implement the idea in real world by doing the required activities and spend some money.

3.6. Marketing phase

Marketing is the process that motivate customer to use or apply goods or services.

4. Knowledge management methods

Knowledge is a crucial resource for competitive advantage (Decarolis and Deeds, 1999; Kogut and Zander, 1992; Nonaka, 1994). Effective use of knowledge flow is likely to have positive impact on product innovation performance through providing valuable information about customers and markets that is essential to new product development practices (Cooper, 1979a,b; 1982; Calantone and Di Benedetto, 1988; Montoya-Weiss and Calantone, 1994). There are several methods to manage knowledge in firms. Knowledge management methods as stated by Hoegl and Schulze (2005) are:

4.1. Informal Events

Informal events in a firm are all kinds of events which are meant to encourage conversation, open communication, and informal knowledge sharing.

4.2. Experience Workshops

In experience workshops people from the project team take a retrospective view and address the questions of what could be learned from the project, how they judge the project's success (or lack of success) and what could be learned in order to improve subsequent projects. The objective is the exchange of experiences among the project team members. In this knowledge management method emotion is also important.

4.3. Communities of Practice

Communities of practice are groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge in expertise in this area by interacting on an ongoing basis. E.g., engineers who design a certain kind of electronic circuit find it useful to compare designs regularly. By tacit knowledge community members share new tools, designs and manuals can be created (Wenger, McDermott and Snyder, 2002).

4.4. Project Briefings

Project briefings are suggested to be applied before new projects start. Therein, experienced employees pass on their knowledge and experiences from prior projects to team members of the current project or the newly-begun project. The transfer of knowledge usually takes place in workshops that can be structured or unstructured.

4.5. Expert interviews

It means elicit, codify, and transform the expert's knowledge into a sharable format. Instead of clear-cut rules, experts often have heuristics – rules of thumb – that they find useful in the exercise of their abilities. Such heuristics, although not completely describing the execution of an expertise, are often useful to others.

4.6. Best practice

Best practice descriptions include a statement of the problem being solved, the circumstances that are relevant to the case, the steps one has to go through in the solution of the problem, and the specification of useful information required to fulfil the task and reach the outcome.

The transfer of best practices connotes the firm's replication of practices that are performed in a superior way and is deemed superior to alternate practices. In order to indicate best practices, several common and good practices have to be compared.

4.7. Knowledge Broker

The specialization and separation that help business units to maintain focus also hamper communication. Internal competition magnifies the problem. It encourages groups to hoard rather than share what they have learned. Here, the assignment of knowledge brokers is recommended. They build reputation as trusted third parties, thus getting access to various internal but also

external knowledge sources. The primary task of a knowledge broker is to connect knowledge seekers to sources of knowledge in a particular topic area.

4.8. Experience Reports

Experience reports include positive as well as negative experiences, while best practices are characterized by descriptions of effective and successful processes only. The purpose of experience reports is to assess, to document, and therefore to capture the valuable knowledge developed during the project. In the form of reports, the new knowledge can be diffused fairly easily throughout the company, bridging distance in terms of time and physical dispersion, and as a consequence, others can learn from it. The range and scope of the report document and of the audience that is seeking to learn from the organization's experience should be determined before writing the report.

4.9. Databases

Databases allow explicit knowledge to be stored and made accessible. Repositories that store knowledge artefacts must be kept current, accessible, and coded in such a way as to allow seamless and intuitive accessibility. For an improvement of the development and the evaluation of a product concept, databases are strongly recommended. They should contain technological descriptions, marketing forecasts, and budget estimations for products already developed (Hoegl and Schulze, 2005).

4.10 Research Services

When during NPD a need for professional knowledge emerges, research services can be utilized to provide this knowledge. Depending on the size of the company and the business, professional researchers can be employed or commercial research services used. Professionals should be employed by larger companies or companies with special needs, while smaller companies should make use of commercial services (Hoegl and Schulze, 2005). Also Gupta et al Discussed about Outsourcing knowledge intensive activities to knowledge process organizations (KPOs) to reduce innovation process obstacles. (Gupta et al, 2009).

5. Research Methodology

Myers notes that the case study is widely used in information systems research (Myers 1997), and is compatible to different philosophical perspectives, including positivist and interpretive (Darke, Shanks & Broadbent 1998). In addition, Yin explains that the case study technique is well suited for exploratory question of the "how" or "why" type (Yin 1994). They are appropriate for environments where the researcher has little or no control, or when the phenomenon under investigation cannot be isolated from its context.

The result of this paper is based on two case studies. Both cases are mobile telephone operator in Iran. They work in a competitive market; therefore innovation is a key competitive advantage. Case 1 is a leader in this market and is more innovative than case 2. The number of the employees in case 2 is less than case 1.

Semi-structured interviews with the managers of engaged division in innovation process used to collect data.

6. Case studies

There are three mobile operators that have competed with each other. In 2010, the most popular of them, has 37 million users in Iran and 70% market share in 2004 decreased to 62% in 2010 and the least popular has 500,000 users in Iran and less than 10% market share in 2004 decreased to 1% in 2010. In 2006, another mobile operator has entered in this market with strong financial support and it is expected to attract a lot of users. But it has reduced 8% of the first operator market share. The first operator is still the best operator because of its innovative product and services, but the second operator could not remain competitive and is leaving the market.

Therefore, we chose the first mobile operator as case 1 which has innovative procedures to introduce innovative and new product and marketing. Revenue of case 1 is annually increased by the rate of 40% and entered the Iranian stock market in 2010. The second mobile operator is chosen as case 2 because of losing its market share during six years ago. We do not have any access to information about the third operator. Therefore, we did not enter this operator in our study. In this paper, we study the innovation process in these two cases that it is the most important factor to remain in the competitive market.

There are two kinds of innovation process, pull and push, in case 1 but in case 2 only push innovation process is active. The specifications of these processes in both cases are described in two next subsections.

6.1. Pulled innovation in Case 1 and Case 2

Unlike Case 2, Case 1 has a suggestion system. Suggestion system promotes staff's innovation in order to improve process and procedures of business. It has an official process started by recording an idea and ended with implementation of the ideas. Suggestion system includes several sub processes which are according to the stage of innovation management. First, all staff's ideas is recorded in database system and assigned a code for pursuing results. This way lead to secure handling of the idea and staffs confidentially release the idea. In this system, the ideas are safe from theft and acceptance of them is not affected by personal view in organizational hierarchy. Two aforementioned points have an impressive effect on staff's trust for generating new idea.

Then, this system improve staff trust to explicit their innovative ideas. Therefore, staffs are interested in participating in innovation process and there are a lot of proposal comes from various departments in this case. If the adopted ideas are generated by group, the rewards will be increased. This encourages people to work together.

Following is described the application of the KM methods in the stages of the innovation process in Case 1 and Case 2.

6.1.1. Idea generation

Case 1: Pursuing capability of suggestion system in Case1 motivates people to express and record their initiatives. Each idea is presented in intranet by a unified code so the new ideas are shared among all people and potential of idea generation is improved.

Holding on annual festivals is another notable point in case 1 that stimulates idea generation. In these informal events, the best ideas are rewarded. By using this knowledge management method, participants can communicate with each other and share their tacit knowledge.

As shown in table 1, other knowledge management methods are not employed in idea generation stage so we proposed to case 1 to use these methods in idea generation sub process of innovation process such as best practice, project briefing and etc in order to enhance the innovation process in their company.

Case 2: There is no systematic approach to record and pursue the ideas in case 2 which support employee to generate idea. Just some informal motivating tools such as increasing salary, promoting organizational position etc are used with no commitment to execute. Hence, this case performs weakly in idea generation stage of innovation process. Although customer ideas are gathered through company portal and customer survey and checked by marketing function, but no mechanisms exist to strengthen idea generation by customer. In general, as shown in table 1, none of knowledge management methods are employed by case 2 in this stage.

6.1.2. Decide to develop idea

Case 1: In case 1, to evaluate the recorded idea, first, the required document must be sent to related professional division. Then, experts of related division participate in meeting to decide to accept or reject the ideas. If the communication among employees with different expertise from various divisions is needed, a person who has comprehensive view to all related field will play the knowledge broker role.

Case 2: All received ideas sent to marketing function to decide rejection or acceptance by holding meetings. If marketing team recognizes that the idea is practically executed then it will be accepted and sent to the next step for developing otherwise it will be rejected. Because participating member have different point of view and discuss about the idea so communities of practice is used as a knowledge management method.

6.1.3. Development

Case 1: Sometimes the ideas should be complemented or specified in more details. In such cases, idea owners and related experts discuss about unclear point and amplify the ideas to

implement. But in this case, ideas are often complete enough to implement and this stage is not needed. In special case, communities of practice are used for idea development.

Case 2: To complete the accepted idea for execution, marketing function send it to related expert in organization. After a specified time interval, received comments are put together. Then, internally various meeting are held to evaluate completed ideas. To confirm that there is no serious problem for execution, the output of these meetings are sent to various functional managers. Marketing function plays the role of knowledge broker and meetings are some kinds of communities of practice.

6.1.4. Decision to implementation

Case 1: A committee including the CEO, adjuncts and the secretary of the engineering committee decide to implement the idea and assign the required budgets in Case 1. So the community of practice is used as knowledge management methods in this stage.

Case 2: After development stage, board of directors decides about the execution of the ideas in regular meetings in Case 2. If in these meeting, implementation of the idea is confirmed, the required budget is assigned. Therefore in this stage, communities of practice, a knowledge management method, are used, too.

6.1.5. Implementation

Case 1: In this case, after confirmation of strategic committee about implementation, the required activities assign to related division as daily tasks. Practitioners sometimes necessitate exchanging information or knowledge and making decision about details to do the defined tasks through meetings.

When the various divisions are engaged in implementation stage, someone who has overall view behaves as a knowledge broker.

Case 2: Before offering new services to customers, in pilot implementation new services run for internal employees who use the company services. After getting feedback from internal customers and comparing the result with the same services from other internal and external companies, strengths and weaknesses become apparent. After removing weakness points by corrective actions, the next stage (Marketing) commences. If the weakness points are not removable, the implementation of the idea will be stopped. Best practice used as knowledge management method.

6.1.6. Marketing

Case 1: Pulled innovation in case1 leads to process improvement which is the way of doing work and is not related to new product development. Customers are employees who execute this process, and then marketing is not separate stage in pulled process. So in such innovation, marketing means accept the changes from employee in implementation and development stages. Therefore, applying the tools to justify employees better can be effective.

Marketing stage is used separately in pushed innovation of this case, because of the target of such innovation is to develop a new product, we express these innovation type in next section.

Case 2: Marketing is performed via advertising channels like SMS, website, TV advertising, brochure and etc. to decide about the using these channels, the communities of practice are formed. We suggest using external research services and informal events (such as holding ceremony and sponsor of contests).

It is notable that the results cannot be extended to all pulled innovation process and depends on the aim of pulled process. If pulled process lead to develop new product, it is necessary to use knowledge management methods that transferred the required knowledge about functionality of product to market and also feedback of market get to company for product improvement.

Table 1: Application of knowledge management methods to pulled innovation in Case 1 and Case 2

	Idea generation		Decide to develop		Development		Decide to implement		Implementation		Marketing	
	Case 1	Case 2	Case 1	Case 2	Case 1	Case 2	Case 1	Case 2	Case 1	Case 2	Case 1	Case 2
Data Bases	x											
Communities of Practice			x	X	x	X		X				x
Knowledge Broker			x	x	x	x	x		x			
Research Services									x			
Informal Events	x								x			
Best Practice Cases										x		
Project Briefing												
Experience Workshops												
Expert Interviews												
Experience Reports												

6.2. Pushed innovation in Case 1

The new required mobile telephone features in Iranian market is initiated by the international leader companies and case 1 just customize capabilities based on Iranian mobile telephone infrastructure. According to definition given in section 3, we call this kind of innovation as pushed.

6.2.1. Idea generation

Initial idea in pushed innovation process in case 1 is provided by benchmarking. The idea should be presented in detail in a project plan format. Then new ideas of employee which have not enough details are disclosed. Therefore only best practice used as knowledge management method and other methods are recommended for case 1 to enhance idea improvement.

In case 1, there are some systems such as reward system, paying the cost of submission papers and participating in conferences and etc to motivate people to think and research about new product development. In reward system, the more new idea and research plan from division, the more reward for all employees of the division. This motivates people to help each other in order to research and making idea so knowledge sharing is reinforced.

6.2.2. Decision to develop and Development

As stated in section 6.2.1, in pushed process of case 1, the ideas are presented as details in a project plan, so decision to development and development stages are not applicable.

6.2.3. Decision to implement

In such a pulled process, this stage is performed by a committee including the CEO, adjuncts and the secretary of the engineering. So the community of practice is used as knowledge management methods in this stage.

6.2.4. Implementation

Because the idea is represented in the project plan format, then required resources and project team are specified. Hence project manager act as a coordinator, project team perform their tasks and also the communities of practice are formed frequently to share knowledge among team work. Also team work benefit from the research service of others outside the company.

6.2.5. Marketing

Marketing is performed via advertising channels like SMS, website, TV advertising, brochure etc. to decide about the using these channels, the communities of practice are formed. Also marketing group recognizes potential customers and executes customized advertising programs. We suggest using external research services and informal events (such as holding ceremony and sponsor of contests).

Table 2: Application of knowledge management methods to pushed innovation in case 1

	Idea generation	Decide to develop	Development	Decide to implement	Implementation	Marketing
Data Bases						x
Communities of Practice				x	x	x
Knowledge Broker					x	
Research Services					x	
Informal Events						
Best Practice Cases	x					
Project Briefing						
Experience Workshops						
Expert Interviews						
Experience Reports						

In Case 1, Pushed process does not have two stages "decide to develop" and "development".

7. Conclusion

In spite of the research in the area of knowledge management and innovation, only few studies discuss the contribution of the Knowledge management in each stage of innovation process separately. The objective of this study was to identify the contribution of the Knowledge management methods in improvement of various stages of innovation process. Therefore we chose two Iranian mobile telephone operators in a competitive market. Case 1 was more innovative than case 2. We observed two kind of innovation process in case 1 (pulled and pushed innovation process). In this study, it was found that pulled and pushed performed in different stage so employed Knowledge management method also were somehow different. The following results are obtained from this study:

1. Knowledge management methods promote innovation process.

According to Table 1, we can see that case 1 uses knowledge management methods more than case 2. For example in the idea generation stage, databases and informal events of the knowledge management methods are used in case 1 but case 2 use none of these methods in this stage. Databases method helps the employees in innovation process by storing all new ideas. This method is implemented by suggestion system. Suggestion system in case 1 provides a formal and structured approach to handle pulled innovation process. This approach has moderated the effect of hierarchical organization structure which obstacles the creativity of employees. We believe that it helps case 1 to be more creative than case 2.

Holding informal events provide employees to communicate with each other and share their knowledge and different viewpoints. In the implementation stage, case 1 also uses three methods, while case 2 use only one method. Using knowledge management methods provide a suitable environment to develop creativity and this is an important factor for case 1 to be innovative and successful in competitive market.

2. Knowledge management methods could highly support pushed innovation process.

Unlike Case 2, Case 1 implements some pushed processes and use the KM methods to improve them. This type of process suggests new procedures to improve services and new products to introduce to the market. Then this is another reason to be successful in this market.

Although the two cases have used some Knowledge Management methods in each innovation process stages, but there are still potential point of improvement in using other effective Knowledge Management methods which are suggested to each case.

3. Knowledge management methods highly contribute in marketing stage of pushed process while Idea generation of pulled process.

Another aspect of our analysis is about the nature of pulled and pushed process. Result in Table 1 and 2 shows that case 1 is different in using the KM methods in the two types of innovation. Because marketing has an important role in pushed process, using knowledge management methods to improve this stage is effective to perform the innovation process successfully. But in the pulled process understanding the market problem is important. Then

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using KM methods in idea generation is useful to understand the problem and different viewpoint to generate the best solution.

Because of the following two reasons, we chose the mobile telephone operators for the investigation, they are: 1) Competitive market forced organizations to execute a new idea as soon as possible, 2) the considerable importance high tech industries.

The result of this study may not be extended to all industries. As a future research, it is recommended to extend this investigation to other industries in order to get general result.

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